

Appendix D Analysis and Evaluation Processes

Appendix D-1 Suggested Practice-Program Progress Review Process

The Program Progress Review (PPR):

- Provides a program status for management review,
- In a standard format.

PPR presentations are prepared based on scheduled PPRs.

The program manager is responsible for preparing and delivering the PPR presentation.

Office Director assigns PPR preparation to program manager.

Program manager prepares PPR.

Program manager delivers PPR presentations.

a. Background and Purpose

The purpose of the Program Progress Review (PPR) is to present periodic status of each program for management review. To ensure that the information presented is complete, a standard presentation slide format has been developed.

PPR presentation slides and handouts will be prepared for scheduled PPRs at times set by management. The PPR presentations outline the mission, tasks, schedule, resources (both personnel and fiscal), deliverables, and other agency interface issues for each program.

b. PPR Development

The program manager's assigned responsibility for preparing the PPR by the cognizant Office Director (or Division Director).

The program manager delivers the PPR presentation on dates set by management.

Approved PPR presentation materials will be collated into a booklet which will be made available on the date of the PPR. Provide approximately 15 copies.

c. Instructions for the Preparation of Program Progress Reviews

The PPR consists of a series of slides to present program status to all levels of management. The following instructions for preparing PPRs are provided to ensure consistency. These instructions are meant to establish the minimum content required and a recommended style and format for the first round of PPR presentations. A sample PPR is provided on page D-2. Program managers have the flexibility to change the format and graphics to suit their needs. As reviews are held, it is likely that the requirements will be updated.

Program

On the first slide state the presentation title, “Program Progress Review”. Below the revision number state the name of the program manager followed by a short description of the program mission. Place the presentation date and the page number on the lower right hand corner of the slide.

For the remaining slides in the presentation, the header will contain the program title. The footers will contain the presentation date and the page number in the lower right hand corner.

Program ____ Program Progress Review

Program Title

Name of Program Manager

Short Description of the Program Mission

Date Page #

Programmatic Strategic Objectives Slide

List the program strategic objectives in bullet form. If needed, a continuation slide may be used with the same headers and footers.

Program Title

Programmatic Strategic Objectives

- Program Strategic Objective
- Program Strategic Objective
- Program Strategic Objective

Date Page #

Key FY Tasks Supporting Strategic Objectives Slide

Detail each key task, the strategic objective which it supports, the description of the task, the person responsible, the deliverable/ accomplishment schedule, the financial expenditures, technical accomplishments, and technical issues. Present each key task on a separate slide and format in the same order as described above.

Continuation sheets using the same headers and footers can be used as needed to present the remaining tasks or to present more detail.

Program Title

Key FY Task Supporting Strategic Objective

Key Task (one key task per slide)

Task Description

Responsible Individual

Deliverable/Accomplishment Schedule

Financial Expenditures

Technical Accomplishments

Technical Issues

Date Page #

Fiscal Resources Slide

Outline the FY budget broken down by each strategic objective and identify capital expenditures and whether carryover funds from prior FYs exist. The slide is generated by creating a table or pie chart with each strategic objective and dollars (in thousands) identified which are budgeted for that strategic objective. Total the last column to represent the entire program budget. Identify carryovers from previous FYs and capital equipment expenditures on the bottom of the slide.

Program Title

Fiscal Resources

(Table or Pie Chart)

Strategic Objective Fiscal Year Budget

Capital Expenditure

Carryover Funds

Date Page #

Program Expenditure Summary Report Slide

Provide a graph that details program expenditures relative to planned, actual authorized, and actual obligated funds. This graph should be generated using the data from the spend plan. Be sure to list the amount of funds planned, actual authorized, and actual for each month throughout the fiscal year. Plot on the graph, the planned, actual authorized, and actual funds on the vertical axis with date (by month) on the horizontal axis.

Program Title

Program Expenditure Summary Report

(Graph)

Funds Planned

Actual Authorized

Actual

for each month of the fiscal year.

Date Page #

Funding Issues Slide

Detail relevant issues with respect to program funding. The slide is formatted by listing funding issues in a prioritized bullet format. This slide can be deleted if no relevant funding issues exist. Any carryover funds should be listed and justified.

Program Title

Funding Issues

- Funding Issue
- Funding Issue
- Funding Issue

Date Page #

Personnel Resource Issues Slide

Detail, in a bullet format, any personnel resource issues such as labor shortfalls or surpluses which impact the program. This slide will be generated on an as needed basis.

Program Title

Personnel Resource Issues

- Personnel Resource Issue
- Personnel Resource Issue
- Personnel Resource Issue

Date Page #

Major Hardware Deliverables Slide

Identify each major hardware deliverable and its completion status. Minor deliverables can be consolidated for the presentation. The slide is prepared as a table or Gantt chart listing the project number, the number of the strategic objective on which the project is focused, the name of the deliverable, the name of the responsible person, the planned completion date, and the status of each major hardware deliverable. The status will be reported as “on schedule”, “expected to slip/(new date)”, or “completed/(date)”.

Program Title

Major Hardware Deliverables

(Table or Gantt Chart)

Major Hardware Deliverable - Completion Status and Date,
Project Number, Strategic Objective Number, Document Name,
Responsible Person

Date Page #

Major Document Deliverables Slide

Identify each major document deliverable and its completion status. The slide is prepared similarly to the hardware deliverable slide, again as a table or Gantt chart listing the project number,

the number of the strategic objective on which the project is focused, the name of the deliverable document, the name of the responsible person, the planned completion date, and the status of each major document deliverable. The status will be reported as “on schedule”, “expected to slip/(new date)”, or “completed/(date)”.

Project Title

Major Document Deliverables

(Table or Gantt Chart)

Major Document Deliverable - Completion Status and Date, Project Number, Strategic Objective Number, Person Responsible, Completion Date

Date Page #

Interagency Initiatives/Issues Slide

Identify any current or recently accomplished interagency initiatives and issues. The slide is formatted by listing interagency initiatives/issues in a bullet format. This slide will only be presented for the first PPR and whenever new initiatives/issues develop.

Program Title

Interagency Initiatives/Issues

- Interagency Initiative/Issue
- Interagency Initiative/Issue
- Interagency Initiative/Issue

Date Page #

International Activities Slide

Detail any significant international activities which affect the program. This slide will be presented on an as needed basis.

Program Title

International Activities

Significant International Activity Information Impacting Program

(Delete slide if no international activity exists).

Date Page #

Program Interfaces & Support Slide

Identify outside organizations and activities contributing to the project. The slide highlights new partners and issues and will be prepared as a table listing the organization, the name and phone number of each contact person, and the activity for which that person/organization is involved. *This slide only needs to be presented for the first PPR and whenever there has been changes to this information.*

Program Title

Program Interfaces & Support

(Table)

Outside Organization and Activity

Contact Person, Phone Number

Date Page #

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Appendix D-2 Peer Review at the Department of Energy

1 PEER REVIEW AT THE DEPARTMENT OF ENERGY

1 INTRODUCTION

MERIT REVIEW WITH PEER EVALUATION IS A POWERFUL AND EFFECTIVE TOOL FOR ENHANCING RELEVANCE AND PRODUCTIVITY IN FEDERAL RESEARCH AND DEVELOPMENT (R&D). DESPITE SOME OF ITS WELL-DOCUMENTED SHORTCOMINGS,¹⁷ PEER REVIEW STIMULATES COMPETITION, ESTABLISHES HIGH STANDARDS FOR QUALITY, REWARDS PRODUCTIVITY, AND, ON BALANCE, FOSTERS CREATIVITY AND PROMOTES FAIR PLAY. WHEN COMBINED WITH ENERGETIC AND VISIONARY R&D PROGRAM LEADERSHIP, PEER REVIEW CAN MARSHAL HIGHLY COMPETENT R&D TEAMS, FOCUS SCARCE RESOURCES ON THE MOST IMPORTANT AND POTENTIALLY FRUITFUL TECHNICAL OPPORTUNITIES, AND PROVIDE REASONABLE ASSURANCES TO TAXPAYERS THAT THEIR FEDERAL R&D DOLLARS ARE BEING PRUDENTLY INVESTED.

ON MAY 6, 1994, IN A WHITE HOUSE MEMORANDUM, THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY (OSTP) AND THE OFFICE OF MANAGEMENT AND BUDGET (OMB) ESTABLISHED MERIT REVIEW WITH PEER EVALUATION AS AN "R&D POLICY PRINCIPLE" TO BE INCORPORATED IN ALL FEDERAL AGENCY R&D BUDGETS FOR FISCAL YEAR 1996. SPECIFICALLY, ACCORDING TO THE MEMORANDUM, EACH FEDERAL R&D AGENCY IS EXPECTED TO

"SIGNIFICANTLY ENHANCE THE UTILIZATION OF MERIT REVIEW WITH PEER EVALUATION AND COMPETITIVE SELECTION IN FEDERAL R&D PROJECTS. RESEARCH NOT SUBJECT TO MERIT REVIEW WITH PEER EVALUATION IS EXPECTED TO DECLINE AND FUNDING IN THESE AREAS SHOULD BE MOVED INTO AREAS OF MERIT-REVIEWED RESEARCH WITH PEER EVALUATION."

FURTHER, INCREASING CONCERN ABOUT ACCOUNTABILITY FOR EFFICIENT AND PRODUCTIVE USE OF GOVERNMENT FUNDS, INCLUDING FUNDS FOR GOVERNMENT-SUPPORTED R&D, HAS BEEN REFLECTED IN RECENT FEDERAL LEGISLATION AND EXECUTIVE DIRECTION. THE CHIEF FINANCIAL OFFICERS ACT, THE GOVERNMENT PERFORMANCE AND RESULTS ACT, THE COMPETITION IN CONTRACTING ACT, THE REVISION OF THE FEDERAL ACQUISITION REGULATION, THE NATIONAL PERFORMANCE REVIEW INITIATIVE, AND A NUMBER OF OTHER PROGRAM EVALUATION INITIATIVES FROM OMB HAVE ALL HAD A PROFOUND EFFECT ON FEDERAL AGENCY MANAGEMENT, OVERSIGHT, AND CONDUCT OF R&D PROGRAMS.

THE DEPARTMENT OF ENERGY (DOE) FULLY EMBRACES THESE PRINCIPLES OF ACCOUNTABILITY, COMPETITION, AND OBJECTIVE MERIT REVIEW, INCLUDING PEER REVIEW. IN FACT, IT HAS ALREADY PUT IN PLACE MANY NEW WAYS OF DOING BUSINESS THAT ARE STRENGTHENING THEIR APPLICATION. THIS PAPER DOCUMENTS THE DEPARTMENT'S CONTINUING AND EXPANDING COMMITMENT TO THESE PRINCIPLES AND, IN PARTICULAR, TO PEER REVIEW.

1 SCOPE OF PEER REVIEW AT THE DEPARTMENT OF ENERGY

AT THE DEPARTMENT OF ENERGY, PEER REVIEW MEANS COMPETENT, QUALIFIED, OBJECTIVE, AND FORMAL EVALUATION USING (1) SPECIFIED CRITERIA AND (2) THE REVIEW AND ADVICE OF QUALIFIED PEERS. TO BE QUALIFIED, PEERS MUST BE TECHNICALLY COMPETENT IN THE SCIENTIFIC AND TECHNICAL FIELD UNDER REVIEW. PEERS MAY COME FROM ANY SOURCE, INCLUDING INDUSTRY, ACADEMIA, AND GOVERNMENT AGENCIES AND ASSOCIATED LABORATORIES. TO BE OBJECTIVE, PEERS MUST BE REASONABLY INDEPENDENT AND FREE FROM CONFLICT OF INTEREST. THE RESULTS OF PEER REVIEWS MUST BE RECORDED AND, UNDER APPROPRIATE CONTROLS, ACCOUNTABLE TO FURTHER REVIEW.

MERIT REVIEWS MEETING THESE CRITERIA TAKE ON MANY AND DIVERSE FORMS. THEY ARE APPLIED TO R&D PROPOSALS, PROJECTS, AND PROGRAMS. THEY ARE APPLIED, AS WELL, TO THE DESIGN AND ACQUISITION OF MAJOR RESEARCH FACILITIES AND TO THE FORMULATION OF MULTIYEAR RESEARCH PLANS AND STRATEGIES. APPROPRIATE FORMS OF PEER REVIEW ARE CONSTRUCTED AND APPLIED TO ACTIVITIES AT VARIOUS ORGANIZATIONAL LEVELS: THE DEPARTMENT SECRETARY, ASSISTANT SECRETARIES, PROGRAM OFFICES, NATIONAL LABORATORIES, INTEGRATED LABORATORY R&D, RESEARCH SUBCONTRACTORS (INCLUDING UNIVERSITIES), AND LABORATORY USER FACILITIES. THE NATURE OF PEER REVIEW AT EACH LEVEL IS TAILORED TO THE NEEDS AT THAT LEVEL.

PEER REVIEWS ARE USUALLY UNDERTAKEN IN THE CONTEXT OF THE ALLOCATION AND USE OF SCARCE R&D RESOURCES. THEY MAY BE USED IN CONJUNCTION WITH COMPETITIVE SELECTION PROCESSES, WHERE PEER REVIEWS TAKE PLACE PRIOR TO THE AWARD OR APPROVAL OF A GRANT OR CONTRACT, OR WHERE THE RESEARCH ACTIVITIES ARE CHOSEN FROM A POOL OF QUALIFIED APPLICANTS FOLLOWING PEER REVIEWS. THESE TYPES OF PEER REVIEW ARE CALLED PRE-AWARD, OR PROSPECTIVE, REVIEWS. PEER REVIEWS MAY ALSO BE USED IN CONJUNCTION WITH EVALUATIONS OF ONGOING OR RECENTLY COMPLETED RESEARCH. THESE IN-PROGRESS OR PERFORMANCE REVIEWS ARE CALLED POST-AWARD, OR RETROSPECTIVE, REVIEWS. THESE LATTER REVIEWS ALSO STRONGLY INFLUENCE THE ALLOCATION OF R&D RESOURCES BY WHAT IS SOMETIMES REFERRED TO AS SELECTION BY COMPETITIVE SURVIVAL.

ALTHOUGH THE TERMS PROSPECTIVE AND RETROSPECTIVE ARE USEFUL CONSTRUCTS TO DESCRIBE WHEN MERIT REVIEWS WITH PEER EVALUATION TAKE PLACE, THE SUBSTANCE OF BOTH TYPES OF REVIEWS ARE QUITE SIMILAR. IN BOTH CASES, THE MERIT OF AN INVESTIGATOR'S OR RESEARCH GROUP'S RECORD OF ACCOMPLISHMENTS (RETROSPECTIVE CONSIDERATIONS) AND THE PROJECTED COURSE OF FUTURE RESEARCH (PROSPECTIVE CONSIDERATIONS) BEAR DIRECTLY ON THE EVALUATION.

1 STATUTORY AND REGULATORY CONTEXT

THE DEPARTMENT OF ENERGY, LIKE OTHER FEDERAL R&D AGENCIES, MUST CARRY OUT ITS SCIENTIFIC AND TECHNICAL MISSIONS WITHIN A LARGER CONTEXT OF STATUTORY, REGULATORY, AND PROCEDURAL REQUIREMENTS GOVERNING THE EXPENDITURE OF R&D FUNDS. THIS CONTEXT VARIES FOR DIFFERENT PROGRAMS, BUT IN EACH CASE LARGELY DETERMINES THE WAY IN WHICH PEER REVIEW PRINCIPLES AND METHODS ARE APPLIED.

¹⁷Chubin, Daryl E. and Hackett, Edward J., *Peerless Science: Peer Review and U.S. Science Policy*. (Albany, NY: State University of New York Press, 1990).

THE AWARD OF RESEARCH CONTRACTS, FOR EXAMPLE, IS GOVERNED BY THE FEDERAL ACQUISITION REGULATION AND THE COMPETITION IN CONTRACTING ACT, BOTH OF WHICH REQUIRE COMPETITION AMONG BIDDERS AND FORMAL SELECTION PROCESSES. THE DEPARTMENT EMPLOYS PEER REVIEW PRINCIPLES AND METHODS, INCLUDING THE USE OF INDEPENDENT ENGINEERING AND SCIENTIFIC REVIEWERS, IN THE TECHNICAL EVALUATION STAGE OF ALL SUCH SELECTION PROCESSES RELATED TO R&D, EXCEPT IN RELATIVELY RARE INSTANCES WHERE SOLE-SOURCE SELECTION MAY BE JUSTIFIED.

FURTHER, THE AWARD OF RESEARCH GRANTS AND COOPERATIVE AGREEMENTS IS GOVERNED BY THE DEPARTMENT'S FINANCIAL ASSISTANCE RULES, AS PROMULGATED IN THE CODE OF FEDERAL REGULATIONS (10 CFR PART 600). THE DEPARTMENT'S MAJOR RESEARCH ORGANIZATIONS HAVE PROMULGATED FORMAL RULES IN THE CFR GOVERNING THE MERIT REVIEW PROCESS FOR R&D FINANCIAL ASSISTANCE. THESE RULES REQUIRE THE USE OF TECHNICAL EXPERTS TO PERFORM CREDIBLE MERIT REVIEWS OF ALL APPLICATIONS, SOLICITED AND UNSOLICITED. SUCH MERIT REVIEWS MAY MAKE USE OF STANDING COMMITTEES, AD HOC COMMITTEES, OR FIELD READERS, AND GENERALLY INCLUDE, IN THE SPIRIT OF PEER EVALUATION, AT LEAST THREE QUALIFIED PERSONS FROM OUTSIDE THE AWARDING PROGRAM OFFICE, IN ADDITION TO THE DESIGNATED CONTRACTING OFFICER'S REPRESENTATIVE.

A COMBINATION OF FEDERAL AND DEPARTMENTAL REGULATIONS ALSO GOVERNS THE AWARD OF CONTRACTS AT THE DEPARTMENT'S LABORATORIES. UNDER THE FEDERAL ACQUISITION REGULATION, A MANAGEMENT AND OPERATING (M&O) CONTRACT IS RECOGNIZED AS AN APPROPRIATE INSTRUMENT, OR AGREEMENT, UNDER WHICH THE GOVERNMENT

"CONTRACTS FOR THE OPERATION, MAINTENANCE, OR SUPPORT, ON ITS BEHALF, OF A GOVERNMENT-OWNED OR CONTROLLED RESEARCH, DEVELOPMENT, SPECIAL PRODUCTION, OR TESTING ESTABLISHMENT WHOLLY OR PRINCIPALLY DEVOTED TO ONE OR MORE MAJOR PROGRAMS OF THE CONTRACTING FEDERAL AGENCY."

SUCH M&O CONTRACTS PERMIT THE DEPARTMENT TO DRAW UPON, NURTURE, AND MAINTAIN THE SPECIAL TECHNICAL EXPERTISE AND CAPABILITIES REQUIRED FOR UNIQUE MISSIONS, SUCH AS THOSE ASSOCIATED WITH NUCLEAR WEAPONS AND LARGE, MULTIDISCIPLINARY, INTEGRATED, NON-WEAPONS RESEARCH. OVER THE YEARS, THE DEPARTMENT'S MISSIONS AND ASSOCIATED REQUIREMENTS FOR SUCH SPECIALIZED EXPERTISE AND CAPABILITIES HAVE GIVEN RISE TO THE DEPARTMENT'S LABORATORY SYSTEM. ALTOGETHER, THE REPLACEMENT COST OF THE FACILITIES OF THIS SYSTEM IS CURRENTLY ESTIMATED TO EXCEED \$30 BILLION. THE LABORATORIES EMPLOY ABOUT 50,000 PEOPLE, REPRESENTING A CONCENTRATION OF TECHNICAL TALENT THAT INCLUDES MORE THAN 8,500 PH.D.s AND SEVERAL NOBEL LAUREATES.

EXAMPLES OF SPECIALIZED RESEARCH FACILITIES LOCATED AT THESE LABORATORIES INCLUDE ACCELERATORS FOR THE STUDY OF HIGH ENERGY PHYSICS, THE WORLD'S MOST POWERFUL COMPUTERS AND LASERS, SYNCHROTRON LIGHT SOURCES FOR PROBING THE STRUCTURE OF MATERIALS, FACILITIES FOR PRODUCING MEDICAL ISOTOPES, AND INSTRUMENTATION LABORATORIES FOR CHARACTERIZING THE DETAILS OF FLAME PROPAGATION AND COMBUSTION. THE DEPARTMENT OWNS AND MAINTAINS THESE FACILITIES AND, WITH THE EXCEPTION OF THE CLASSIFIED FACILITIES, MAKES THEM AVAILABLE TO RESEARCHERS FROM ALL SECTORS OF THE ECONOMY, PUBLIC AND PRIVATE. THE DEPARTMENT UNDERWRITES THE OPERATING COSTS FOR EXPERIMENTERS WHO OPENLY SHARE THEIR DATA WITH THE SCIENTIFIC COMMUNITY. COMMERCIAL USERS MAY ALSO USE THE FACILITIES TO CONDUCT PROPRIETARY RESEARCH, BUT ON THE CONDITION THAT THEY PARTICIPATE ON A FULL-COST-RECOVERY BASIS. PEER REVIEW IS ROUTINELY EMPLOYED TO ALLOCATE AVAILABLE TIME AND SELECT THE EXPERIMENTS CONDUCTED AT THE MAJOR RESEARCH FACILITIES, WITH SOME FACILITIES HAVING WAITING LISTS EXCEEDING A YEAR.

UNDER A DOE-INITIATED CONTRACT REFORM¹⁸, THE DEPARTMENT'S M&O CONTRACTS NOW REQUIRE, OR WILL SOON REQUIRE, REGULAR PERFORMANCE-BASED MERIT REVIEWS TO ENSURE ACCOUNTABILITY IN M&O CONTRACTOR PERFORMANCE. M&O CONTRACTS THAT DO NOT NOW CONTAIN SUCH REQUIREMENTS WILL INCORPORATE THEM WHEN THE CONTRACTS COME UP FOR RENEWAL OR RENEGOTIATION. IN ADDITION, ALL LABORATORIES HAVE AN ARRAY OF OUTSIDE ADVISORY PANELS THAT PERIODICALLY REVIEW AND ADVISE ON THE RELEVANCE AND PRODUCTIVITY OF LABORATORY-CONDUCTED R&D.

FINALLY, ONE M&O CONTRACTOR SELDOM PERFORMS ALL OF ITS R&D TASKING BY ITSELF. WHETHER UNDER A LEAD-LABORATORY OR OTHER MANAGEMENT ARRANGEMENT WITH THE DEPARTMENT, A PORTION OF THE R&D IS TYPICALLY SUBCONTRACTED TO UNIVERSITIES, PRIVATE LABORATORIES, OR OTHER R&D PERFORMERS. AT THE NATIONAL RENEWABLE ENERGY LABORATORY, FOR EXAMPLE, ONE-HALF OF THE LABORATORY'S TOTAL FUNDING SUPPORTS RESEARCH SUBCONTRACTED TO OUTSIDE R&D PERFORMERS. AT ARGONNE NATIONAL LABORATORY, OAK RIDGE NATIONAL LABORATORY, AND PACIFIC NORTHWEST LABORATORY, THIS FIGURE VARIES BETWEEN 10 AND 20 PERCENT. AT OTHER LABORATORIES, THIS FIGURE IS LESS. ALL SUCH SUBCONTRACTS, LIKEWISE, ARE GOVERNED BY CONTRACT PROVISIONS THAT GENERALLY REQUIRE BOTH COMPETITIVE SELECTION PROCESSES, WHICH IN THE CASE OF R&D GENERALLY INVOLVE MERIT REVIEWS WITH PEER EVALUATION, AND PERIODIC EVALUATIONS OF CONTRACTOR PERFORMANCE.

1 R&D PROGRAMS SUBJECT TO PEER REVIEW

THE DEPARTMENT'S OVERALL R&D BUDGET FOR FISCAL YEAR 1994 IS ESTIMATED, DEPENDING UPON ONE'S PRECISE DEFINITION OF R&D, TO BE ABOUT \$7.4 BILLION, AS SHOWN IN APPENDIX A. THIS AMOUNT MAY BE GROUPED INTO THREE BROAD, ROUGHLY EQUAL, CATEGORIES: FUNDAMENTAL SCIENCE AND ENERGY RESEARCH (\$2.4 BILLION); CIVILIAN ENERGY TECHNOLOGY AND RELATED R&D (\$2.8 BILLION); AND NATIONAL SECURITY R&D (\$2.2 BILLION).

OF THE \$7.4 BILLION TOTAL, APPROXIMATELY 20 PERCENT SUPPORTS RESEARCH CARRIED OUT BY R&D PERFORMERS EMPLOYED OUTSIDE THE DEPARTMENT AND ITS LABORATORY SYSTEM. PERFORMERS INCLUDE INDUSTRY, UNIVERSITIES, PUBLIC AND PRIVATE RESEARCH INSTITUTIONS, AND R&D CONSORTIA. THE INSTRUMENTS USED TO CONVEY FUNDING TO THESE R&D PERFORMERS INCLUDE DEPARTMENT-AWARDED GRANTS, COOPERATIVE AGREEMENTS AND CONTRACTS, AND LABORATORY-AWARDED RESEARCH SUBCONTRACTS.

OF THE REMAINING 80 PERCENT, MOST SUPPORTS RESEARCH AND RELATED ACTIVITIES CARRIED OUT BY PERFORMERS WITHIN THE DEPARTMENT AND ITS LABORATORY SYSTEM. OF THIS, APPROXIMATELY 40 PERCENT SUPPORTS THE OPERATION, MAINTENANCE, CONSTRUCTION, AND MODERNIZATION OF THE SPECIALIZED RESEARCH AND RELATED USER FACILITIES. ANOTHER 35 PERCENT SUPPORTS INTERNAL LABORATORY RESEARCH PROGRAMS. THE REMAINING 25 PERCENT SUPPORTS OTHER FUNCTIONS, INCLUDING GENERAL INFRASTRUCTURE (FOR EXAMPLE, ROADS, UTILITIES), OVERHEAD, AND OTHER INDIRECT COSTS.

THE MIX OF R&D ACTIVITIES CALLS FOR A VARIETY OF APPROACHES TO MANAGING RESEARCH AND APPLYING PEER REVIEW PRINCIPLES AND METHODS.

18U.S. Department of Energy, "Making Contracting Work Better and Cost Less; Report of the Contract Reform Team." (Washington, DC: U.S. Department of Energy, February 1994).

FOR EXAMPLE, RESEARCH BY OUTSIDE R&D PERFORMERS, BECAUSE OF THE NATURE OF THE PROCUREMENT INSTRUMENTS USED TO CONVEY FUNDING, IS GOVERNED BY STATUTORY AND REGULATORY REQUIREMENTS THAT REQUIRE, IN ONE FORM OR ANOTHER, MERIT REVIEWS, MOSTLY WITH PEER EVALUATION, IN CONJUNCTION WITH PRE-AWARD COMPETITIVE SELECTION PROCESSES. THE M&O CONTRACTS ARE, LIKEWISE, COMPETED AND REGULARLY EVALUATED, WITH INCREASING EMPHASIS ON SPECIFIC PERFORMANCE-BASED MEASUREMENT CRITERIA. ALSO, BECAUSE EXPERIMENTAL TIME ON THE SPECIAL FACILITIES IS SO HIGHLY VALUED AND DEMAND EXCEEDS SUPPLY, VIRTUALLY ALL ACCESS TO THE FACILITIES IS ALLOCATED THROUGH SOME MEANS OF MERIT REVIEW WITH PEER EVALUATION.

PEER REVIEW COVERAGE OF THE INTERNAL RESEARCH PROGRAMS AT EACH LABORATORY IS, LIKEWISE, VARIED. THE GREATER PORTION IS SUBJECT TO RETROSPECTIVE MERIT REVIEWS, CALLED FOR BY MANAGEMENT AND CONDUCTED MOST OFTEN BY SCIENTISTS WHO ARE INDEPENDENT OF THE LABORATORY, IN CONJUNCTION WITH OUTSIDE PROGRAM REVIEWS AND ADVISORY COMMITTEE OVERSIGHT. A LESSER PORTION IS SUBJECT TO PROSPECTIVE PEER REVIEW AS EXEMPLIFIED SOMEWHAT NARROWLY BY THE HIGHLY SUCCESSFUL LABORATORY DIRECTORS' DISCRETIONARY R&D PROGRAM AND MORE BROADLY BY THE MANY PROGRAMS MANAGED WITHIN DEPARTMENTAL HEADQUARTERS THAT APPLY PEER REVIEW PRINCIPLES AND METHODS TO THE EVALUATION OF LABORATORY FIELD WORK PROPOSALS. THIS LATTER PROCESS IS ILLUMINATED LATER IN THIS PAPER.

EVEN THOUGH THE DEPARTMENT APPLIES DIFFERENT PEER REVIEW METHODS TO GUIDE ITS RESEARCH PROGRAMS, BOTH OUTSIDE AND INTERNAL, A SAMPLING OF R&D PROJECTS, USING RETROSPECTIVE MERIT REVIEW BY INDEPENDENT EXPERTS, PROVIDES EVIDENCE THAT RESEARCH QUALITY AND RELEVANCE OF BOTH TYPES OF RESEARCH PROGRAMS ARE COMPARABLE. FOR EXAMPLE, AN ORGANIZATION WITHIN THE OFFICE OF ENERGY RESEARCH (THE OFFICE OF PROGRAM ANALYSIS) REGULARLY CONDUCTS, AT THE INVITATION OF R&D PROGRAM MANAGERS, RETROSPECTIVE PEER REVIEWS OF R&D PROGRAMS THROUGHOUT THE DEPARTMENT. USING AN INTERACTIVE METHOD WITH INDEPENDENT, OUTSIDE EXPERT REVIEWERS, THIS ORGANIZATION HAS EVALUATED MORE THAN 2,700 RESEARCH PROJECTS OVER 12 YEARS, COVERING ABOUT 20 PERCENT OF THE DEPARTMENT'S CIVILIAN BASIC RESEARCH AND TECHNOLOGY DEVELOPMENT PROGRAMS. THE MOST RECENT DATA, WHICH INCLUDES 744 RESEARCH PROJECTS IN BASIC ENERGY SCIENCES CONDUCTED AT BOTH NATIONAL LABORATORIES AND UNIVERSITIES, PRODUCED RESULTS SHOWING THAT THE RESEARCH PROGRAMS OF BOTH INTERNAL AND OUTSIDE R&D PERFORMERS SHARED NEARLY IDENTICAL STATISTICAL PROFILES ON RESEARCH QUALITY AND RELEVANCE. THESE RETROSPECTIVE PEER REVIEWS, IT SHOULD BE NOTED, ARE IN ADDITION TO OTHER REVIEWS ADMINISTERED BY THE PROGRAM MANAGERS AND SERVE AS AN INDEPENDENT MEASURE OF RESEARCH QUALITY AND RELEVANCE.

FINALLY, ABOVE THE PROJECT LEVEL, AT HIGHER LEVELS OF DECISIONMAKING IN THE ORGANIZATIONAL HIERARCHY, THE DEPARTMENT MAKES EXTENSIVE, ALTHOUGH NOT COMPREHENSIVE, USE OF EXPERT ADVISORY BODIES, CONSTITUTED UNDER THE FEDERAL ADVISORY COMMITTEE ACT, AND THE NATIONAL ACADEMIES. PEER INPUT IS ALSO OBTAINED FROM WORKSHOPS, TECHNICAL SOCIETY MEETINGS AND SYMPOSIA, AND EXTENSIVE PUBLICATION IN THE PEER-REVIEWED LITERATURE.

1 CURRENT PEER REVIEW PRACTICES AT THE DEPARTMENT OF ENERGY

THE SCIENTIFIC AND TECHNOLOGY DEVELOPMENT MISSIONS OF THE DEPARTMENT OF ENERGY ARE EXTRAORDINARILY DIVERSE AND FAR-RANGING. THE DEPARTMENT IS AMONG THE LARGEST SUPPORTERS OF FUNDAMENTAL SCIENCE AND BASIC RESEARCH ACROSS MANY DISCIPLINARY AREAS AND TECHNICAL FIELDS. ITS APPLIED RESEARCH AND TECHNOLOGY DEVELOPMENT PROGRAMS CONCENTRATE PRIMARILY ON THE DEPARTMENT'S ENERGY, ENVIRONMENTAL, AND NATIONAL SECURITY MISSIONS, BUT IN DOING SO EMBRACE COUNTLESS FOREFRONT AREAS OF RESEARCH VITAL TO INDUSTRY, COMMERCE, AND TRADE. THE DEPARTMENT ALSO BUILDS AND EQUIPS MANY OF THE PREMIER R&D FACILITIES VITAL TO U.S. COMPETITIVENESS AND USED BY U.S. UNIVERSITIES, CORPORATIONS, AND NONPROFIT RESEARCH INSTITUTES.

IN THESE RESPECTS, THE DEPARTMENT IS ENDOWED WITH HIGHLY VALUABLE R&D RESOURCES FOR WHICH THERE IS INTENSE COMPETITION. THE DEPARTMENT HAS FOUND OVER THE YEARS THAT THIS COMPETITION IS MOST PRODUCTIVELY AND EQUITABLY MANAGED BY MERIT REVIEW PRACTICES THAT INVOLVE OBJECTIVE REVIEWS AND ADVICE, THAT IS, BY PEER REVIEW. IT HAS ALSO FOUND, HOWEVER, THAT PEER REVIEW PRACTICES MUST BE APPROPRIATELY TAILORED TO EACH CONTEXT, DEPENDING ON THE NATURE OF THE RESEARCH ACTIVITIES PERFORMED AND THE R&D COMMUNITY SERVED.

FINALLY, AND IMPORTANTLY, PEER REVIEW SYSTEMS AT THE DEPARTMENT DO NOT NOW, NOR MUST THEY IN THE FUTURE, PRECLUDE THE POSSIBILITY OF INITIATING SOME RESEARCH PROGRAMS WITHOUT PEER REVIEW. PRESERVING THIS FLEXIBILITY IS VITAL. PROGRAMS REPRESENTING ENTIRELY NEW RESEARCH DIRECTIONS, RESEARCH AT THE INTERFACES BETWEEN ESTABLISHED COMMUNITIES, OR ESSENTIAL ELEMENTS IN CRITICAL MISSION AREAS OFTEN DO NOT SURVIVE TRADITIONAL PEER REVIEW. IF THE DEPARTMENT HAD APPLIED PEER REVIEW RIGIDLY, WITHOUT FLEXIBILITY OR REGARD TO SUCH WEAKNESSES, IT MIGHT NOT HAVE FUNDED DR. LUIS ALVAREZ, WHOSE WORK ULTIMATELY LED TO THE METEOR-IMPACT THEORY OF THE EXTINCTION OF THE DINOSAURS. THIS WAS WORLD-CLASS SCIENCE — NEUTRON ACTIVATION ANALYSIS OF IRIIDIUM ANOMALIES IN SOIL SAMPLES AT THE CRETACEOUS-TERTIARY GEOLOGIC BOUNDARY — THAT USED THE DEPARTMENT'S SKILLS AND FACILITIES IN NOVEL WAYS THAT LED TO A REVOLUTION IN THINKING ABOUT OUR PLANET AND ITS HISTORY.

1 FUNDAMENTAL SCIENCE AND ENERGY RESEARCH

VIRTUALLY ALL OF THE DEPARTMENT'S FUNDAMENTAL SCIENCE AND ENERGY RESEARCH PROGRAMS UNDERGO MERIT REVIEW OF ONE FORM OR ANOTHER IN ORDER TO ENSURE SCIENTIFIC EXCELLENCE AND MISSION RELEVANCE. PEER EVALUATION IS USED EXTENSIVELY IN THESE MERIT REVIEW PROCESSES.

NEARLY ALL RESEARCH CONDUCTED BY R&D PERFORMERS OUTSIDE THE DEPARTMENT AND ITS LABORATORY SYSTEM IS GOVERNED BY FORMAL PROCESSES OF PROSPECTIVE MERIT REVIEW WITH PEER EVALUATION AND COMPETITIVE SELECTION. SUCH PROCESSES ARE CODIFIED UNDER THE OFFICE OF ENERGY RESEARCH'S FINANCIAL ASSISTANCE PROGRAM (10 CFR PART 605), WHICH, WITH SOME EXCEPTIONS FOR FLEXIBILITY, REQUIRES EACH FUNDED GRANT PROPOSAL TO RECEIVE A MINIMUM OF THREE EXTERNAL PEER REVIEWS. PROPOSALS ARE PEER REVIEWED FOR SCIENTIFIC EXCELLENCE. THIS PROCESS SHARES MANY FEATURES OF THE MERIT REVIEW SYSTEM OF THE NATIONAL SCIENCE FOUNDATION. PERFORMANCE IS ALSO REVIEWED AS PART OF ALL RENEWAL PROPOSALS, WHICH TYPICALLY OCCUR ON THREE-YEAR CYCLES.

INTERNAL RESEARCH PROGRAMS AT THE DEPARTMENT'S LABORATORIES, LIKEWISE, UNDERGO MERIT REVIEW. THESE REVIEWS CONSIST OF A MIX OF PROSPECTIVE AND RETROSPECTIVE REVIEWS, AND IN MANY CASES, BOTH. THEY EMPLOY VARYING DEGREES OF PEER EVALUATION AT BOTH THE LABORATORY AND DEPARTMENTAL OVERSIGHT LEVELS, INCLUDING REGULAR ANNUAL REVIEWS OF PROGRAM MANAGEMENT AND ONSITE PROJECT REVIEWS BY DEPARTMENTAL STAFF. IN ADDITION, ALL LABS, USER FACILITIES, AND MAJOR RESEARCH DIVISIONS HAVE VISITING COMMITTEES OF OUTSIDE EXPERTS

THAT PROVIDE ANNUAL PEER REVIEW OF RESEARCH RELEVANCE AND QUALITY.

EVERY INTERNAL LABORATORY RESEARCH PROGRAM IS ALSO REVIEWED ANNUALLY BY HEADQUARTERS AS PART OF THE LABORATORY FIELD WORK PROPOSAL (FWP) SUBMISSION PROCESS, IN ACCORDANCE WITH THE PROVISIONS OF THE GOVERNING M&O CONTRACTS. FIELD WORK PROPOSALS ARE THE MEANS BY WHICH THE LABORATORIES FORMALLY PROPOSE FUTURE WORK AND SEEK AUTHORIZATION FOR EXPENDING R&D FUNDS. FIELD WORK PROPOSALS MAY VARY IN THE EXTENT OF THEIR SPECIFICITY, BUT IN THOSE PROGRAMS THAT DEPEND HEAVILY ON THE USE OF PROSPECTIVE PEER REVIEW IN APPROVING LABORATORY R&D FUNDING, FWPs ARE REQUIRED TO BE OF PEER REVIEW QUALITY. SUCH PRACTICES ARE ROUTINE IN THE OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH, THE EXPERIMENTAL PLASMA RESEARCH PORTIONS OF THE FUSION ENERGY PROGRAM, SEVERAL MAJOR DIVISIONS OF BASIC ENERGY SCIENCES, AND OTHERS.

IN THE OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH, FOR EXAMPLE, ALL FWPs ARE REQUIRED TO BE OF PEER REVIEW QUALITY AND TO BE EXTERNALLY REVIEWED BY INDEPENDENT EXPERTS. REGARDLESS OF MERIT REVIEW METHOD, ALL RESEARCH PROJECTS ARE ANNUALLY REVIEWED, AND ANY PROJECT MAY BE REDIRECTED OR TERMINATED AS A RESULT OF THESE REVIEWS. ALL NEW PROPOSALS ARE SUBJECT TO MERIT REVIEW WITH PEER EVALUATION.

BECAUSE ONE OF THE PRIMARY GOALS OF ALL SCIENTIFIC RESEARCH IS TO ADVANCE THE FOREFRONT OF KNOWLEDGE, PUBLICATION OF ORIGINAL WORK IS AN ESSENTIAL ELEMENT OF THE OVERALL RESEARCH ACTIVITY. DOE-SUPPORTED SCIENTISTS, WHETHER OUTSIDE R&D PERFORMERS OR INTERNAL TO THE LABORATORIES, ARE CONTINUALLY EVALUATED BY THE QUALITY OF THEIR ORIGINAL RESEARCH AS PUBLISHED IN ARCHIVAL, PEER-REVIEWED JOURNALS. THIS PUBLICATION OF ORIGINAL WORK IN THE OPEN LITERATURE IN ITSELF CONSTITUTES ANOTHER AND IMPORTANT FORM OF PEER REVIEW. THE DEPARTMENT RELIES UPON IT TO BOTH GUIDE AND GAUGE THE RELEVANCE AND PRODUCTIVITY OF ITS INTERNAL RESEARCH ACTIVITIES.

THE DEPARTMENT ALSO MAKES EXTENSIVE USE OF THE NATIONAL ACADEMY OF SCIENCES AND A NUMBER OF STANDING COMMITTEES CONSTITUTED UNDER THE FEDERAL ADVISORY COMMITTEE ACT. THE OFFICE OF ENERGY RESEARCH, FOR EXAMPLE, ROUTINELY OBTAINS ADVICE ON PROGRAM CONTENT, QUALITY, FUTURE DIRECTION, PRIORITIES, AND PROPOSED FACILITIES FROM THE BASIC ENERGY SCIENCES ADVISORY COMMITTEE, THE HEALTH AND ENVIRONMENTAL RESEARCH ADVISORY COMMITTEE, THE HIGH ENERGY PHYSICS ADVISORY PANEL, THE NUCLEAR SCIENCES ADVISORY COMMITTEE, AND THE FUSION ENERGY ADVISORY COMMITTEE. THEIR EXPERT AND INDEPENDENT NATURE ENABLE THESE ADVISORY COMMITTEES TO PROVIDE ADDITIONAL AND VALUABLE OUTSIDE ADVICE USED TO GUIDE THE DEPARTMENT'S R&D ACTIVITIES AT THE OVERALL PROGRAM LEVEL.

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CIVILIAN ENERGY TECHNOLOGY AND RELATED R&D

THE OBJECTIVES OF THE CIVILIAN ENERGY TECHNOLOGY AND RELATED R&D PROGRAMS, SUCH AS THOSE FOCUSED ON ENERGY EFFICIENCY, POLLUTION PREVENTION, ENVIRONMENTAL MANAGEMENT, RENEWABLE ENERGY, COAL, OIL, AND NATURAL GAS, LARGELY AIM AT ADVANCING TECHNOLOGIES FOR USE IN THE GENERAL ECONOMY. THIS MEANS THAT THE MANAGEMENT AND DIRECTION OF SUCH PROGRAMS MUST INVOLVE NOT JUST TECHNICAL EXPERTS, BUT ALSO THOSE WHO WILL ULTIMATELY MANUFACTURE, MARKET, AND USE THE TECHNOLOGIES. THIS CALLS FOR COLLABORATIVE MODES OF R&D REVIEW AND CONDUCT THAT FULLY ENGAGE PARTICIPATION AMONG THOSE WHO UNDERSTAND COMPETITIVE MARKETS AND CONSUMER DEMANDS. ACCORDINGLY, MANY OF THE DEPARTMENT'S ENERGY TECHNOLOGY DEVELOPMENT AND RELATED R&D PROGRAMS ARE DELIBERATELY DESIGNED TO ACCOMMODATE INDUSTRIAL PARTNERS. IN VARIOUS WAYS, THESE INDUSTRIAL PARTNERS PROVIDE SUBSTANTIAL OPPORTUNITIES FOR EXTERNAL MERIT REVIEW BY ENGAGING THEMSELVES AS FULL PARTICIPANTS HELPING TO PLAN, EXECUTE, AND COMMERCIALIZE THE R&D.

IN ADDITION, THE DEPARTMENT MAKES EXTENSIVE USE OF R&D PROCUREMENT ARRANGEMENTS THAT NOT ONLY INVOLVE INDUSTRY, BUT REQUIRE COST-SHARING BY INDUSTRY. SECTION 3002 OF THE ENERGY POLICY ACT OF 1992 ESTABLISHES MINIMUM COST-SHARING THRESHOLDS OF 50 PERCENT FOR TECHNOLOGY DEMONSTRATION AND COMMERCIALIZATION PROJECTS, AND 20 PERCENT FOR ALL OTHER CIVILIAN ENERGY RESEARCH. THE RESULTING CONTRACTS THUS BENEFIT BOTH FROM THE ROUTINE COMPETITIVE SELECTION PRACTICES, AS PRESCRIBED IN SECTION 935.016-1 OF THE DEPARTMENT OF ENERGY ACQUISITION REGULATION, AND FROM ONE OF THE MOST SEVERE OUTSIDE TESTS OF RESEARCH RELEVANCE, THAT IS, SUBSTANTIAL FINANCIAL INVESTMENT FROM INDUSTRIAL R&D PARTNERS.

AT THE DEPARTMENT'S NATIONAL LABORATORIES, THERE IS LIKEWISE A SIGNIFICANT DEGREE OF EXTERNAL REVIEW OF, AND INTERNAL COMPETITION FOR, THE ENERGY TECHNOLOGY DEVELOPMENT AND RELATED R&D PROGRAMS. EVERY LABORATORY HAS AN ARRAY OF INDUSTRIAL ADVISORY PANELS EMPLOYED TO REVIEW THE R&D ACTIVITIES OF EACH OF ITS MAJOR RESEARCH DIVISIONS. INDIVIDUAL RESEARCH INVESTIGATORS MUST CONTINUALLY SUBMIT TO A BATTERY OF SCIENTIFIC AND TECHNICAL REVIEWS, BOTH PROSPECTIVE AND RETROSPECTIVE. PROSPECTIVE EVALUATIONS INCLUDE MERIT REVIEWS OF INDIVIDUAL WORK PROPOSALS, ALMOST ALWAYS INVOLVING INTERNAL PEERS AND SOMETIMES INVOLVING EXTERNAL PEERS. PROSPECTIVE EVALUATIONS ALSO INCLUDE MULTILEVEL INTERNAL REVIEWS OF THE LABORATORIES' FORMALLY SUBMITTED FIELD WORK PROPOSALS BEFORE THEY ARE SENT TO DEPARTMENTAL HEADQUARTERS. RETROSPECTIVE EVALUATIONS ARE PERFORMED ON ALL R&D PROJECTS AT LEAST ANNUALLY, BUT MORE TYPICALLY ARE PERFORMED AS AN INTEGRAL PART OF THE COURSE OF ONGOING RESEARCH — BY COLLEAGUES, LABORATORY SUPERIORS, CLIENTS AT HEADQUARTERS, AS WELL AS BY PEER REVIEWERS OF RESEARCH PUBLICATIONS. IN ADDITION, RETROSPECTIVE EVALUATIONS USING PEER REVIEW ARE EMPLOYED ON AN AD HOC OR SAMPLING BASIS TO REVIEW ONGOING RESEARCH INVOLVING SPECIFIC PROJECTS, COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS (CRADAs), AND OTHER FORMS OF JOINT R&D.

INPUT FROM PEERS IS ALSO OBTAINED FROM CONTRACTOR REVIEW MEETINGS, WORKSHOPS, TECHNICAL SOCIETY MEETINGS, AND SYMPOSIA. FOSSIL ENERGY PROGRAMS AND ENERGY EFFICIENCY PROGRAMS HAVE MADE USE ON A SELECTIVE BASIS OF THE OFFICE OF ENERGY RESEARCH'S OFFICE OF PROGRAM ANALYSIS TO CONDUCT FORMAL, INDEPENDENT, RETROSPECTIVE PEER REVIEWS OF THEIR APPLIED RESEARCH PROJECTS.

PEER REVIEW PROCESSES IN SOME ELEMENTS OF THE DEPARTMENT'S CIVILIAN R&D PROGRAMS ARE CURRENTLY UNDERGOING SIGNIFICANT ENHANCEMENT. THE TECHNOLOGY DEVELOPMENT PROGRAM OF THE OFFICE OF ENVIRONMENTAL MANAGEMENT, FOR EXAMPLE, IS INSTITUTING PEER REVIEW AT THE PROGRAM LEVEL (SEE BELOW), AND IS STRENGTHENING THE USE OF "FOCUS AREA REVIEW GROUPS" AT THE SUB-PROGRAM LEVEL. BEGINNING IN FISCAL YEAR 1995, LABORATORY FIELD WORK PROPOSALS, KNOWN IN THE ENVIRONMENTAL MANAGEMENT PROGRAM AS TECHNICAL TASK PLANS, WILL BE REVIEWED BY TEAMS OF SUBJECT MATTER SPECIALISTS FROM TECHNICAL, REGULATORY, BUSINESS, AND STAKEHOLDER PERSPECTIVES.

VIRTUALLY ALL MAJOR ENERGY TECHNOLOGY DEVELOPMENT AND RELATED R&D PROGRAMS ARE PERIODICALLY SUBJECTED TO HIGHER LEVEL OVERALL PROGRAM REVIEWS INVOLVING EXTENSIVE USE OF SCIENTIFIC AND TECHNICAL EXPERTS AND INDUSTRY STAKEHOLDERS. THE MOST VISIBLE OF THESE ARE REVIEW COMMITTEES OF THE NATIONAL ACADEMY OF SCIENCES AND THE STANDING DEPARTMENTAL ADVISORY COMMITTEES CONSTITUTED UNDER THE AUSPICES OF THE FEDERAL ADVISORY COMMITTEE ACT. THESE BODIES ARE ASKED PRIMARILY TO COMMENT ON THE CONTENT AND DIRECTION OF THE R&D PROGRAMS, INCLUDING THEIR 5-YEAR R&D PLANS AND ASSOCIATED STRATEGIC PLANS.

IN THE TECHNOLOGY DEVELOPMENT PROGRAM OF THE OFFICE OF ENVIRONMENTAL MANAGEMENT, FOR EXAMPLE, TOP-LEVEL PROGRAM REVIEWS ARE CONDUCTED BY THE ENVIRONMENTAL MANAGEMENT ADVISORY BOARD AND, BEGINNING IN FISCAL YEAR 1995, A NEWLY ESTABLISHED COMMITTEE ON ENVIRONMENTAL MANAGEMENT TECHNOLOGIES OF THE NATIONAL ACADEMY OF SCIENCES. SIMILARLY, THE OFFICE OF FOSSIL ENERGY IS ADVISED BY THE NATIONAL PETROLEUM COUNCIL AND THE NATIONAL COAL COUNCIL. ALTOGETHER, THERE ARE EIGHT ACTIVE COMMITTEES ADVISING THE CIVILIAN ENERGY TECHNOLOGY AND RELATED R&D PROGRAMS.

FINALLY, WITH THE IMPLEMENTATION OF STRATEGIC PLANNING AND TOTAL QUALITY MANAGEMENT PRINCIPLES THROUGHOUT THE DEPARTMENT, MOST KEY PLANNING AND PROGRAMMING DECISIONS ARE NOW EVOLVED IN FULL VIEW OF AND WITH BROAD PARTICIPATION FROM OUTSIDE STAKEHOLDERS. FOR EXAMPLE, THE DEPARTMENT'S RECENTLY DEVELOPED MULTIYEAR PLAN FOR INTEGRATED RESOURCE PLANNING WAS DISTRIBUTED TO 350 STAKEHOLDERS IN THE ELECTRIC AND NATURAL GAS UTILITY INDUSTRY, WITH FORMAL COMMENTS RECEIVED FROM 40 REVIEWERS. IN THE DEPARTMENT TODAY, EVERY SUCH PLAN MUST EVIDENCE EXTENSIVE USE OF OUTSIDE INDEPENDENT PARTICIPATION, REVIEW, AND COMMENT.

1 NATIONAL SECURITY R&D

THE DEPARTMENT'S NATIONAL SECURITY RESPONSIBILITIES REQUIRE HIGHLY INTEGRATED, MULTIDISCIPLINARY, MULTIYEAR TEAM EFFORTS. THESE REQUIREMENTS ARE IMPOSED BY BOTH THE COMPLEXITY AND SERIOUSNESS OF THE NUCLEAR WEAPONS ENTERPRISE. THE DEPARTMENT MUST MAINTAIN ITS RESPONSIBLE STEWARDSHIP OF THE NUCLEAR WEAPONS STOCKPILE AND PRESERVE THE SPECIAL NUCLEAR WEAPONS TECHNOLOGY INFRASTRUCTURE AND CORE COMPETENCIES THAT MAY BE NEEDED IN FUTURE NATIONAL SECURITY SITUATIONS. AT THE SAME TIME, IT MUST DISMANTLE NUCLEAR WEAPONS AND DISPOSE OF SPECIAL NUCLEAR MATERIALS, AS SPECIFIED BY INTERNATIONAL AGREEMENT, AND CONTRIBUTE TO THE ENFORCEMENT OF ARMS CONTROL AGREEMENTS AND TO THE PREVENTION OF THE PROLIFERATION OF NUCLEAR WEAPONS. THE R&D NEEDED TO SUPPORT THESE MISSIONS REQUIRES UNIQUE FACILITIES, SPECIAL MATERIALS-HANDLING PROCEDURES, AND HIGHLY CLASSIFIED KNOW-HOW THAT, WHILE AMENABLE TO TECHNICAL REVIEW AND PEER REVIEW, ARE NOT ALWAYS AMENABLE TO THE SAME KIND OF PEER REVIEW PROCESSES THAT ARE EMPLOYED IN THE REALM OF UNCLASSIFIED RESEARCH.

THE DEPARTMENT HAS ESTABLISHED, FOR EXAMPLE, FORMAL PEER REVIEW PROCESSES IN THE OFFICE OF DEFENSE PROGRAMS. WEAPONS LIFE-CYCLE ACTIVITIES ARE ADDRESSED BY FORMALIZED JOINT DEPARTMENT OF ENERGY-DEPARTMENT OF DEFENSE PROJECT TEAMS WHOSE MEMBERS COME FROM BOTH ORGANIZATIONS. THE NUCLEAR WEAPONS COUNCIL PROVIDES A HIGH-LEVEL MECHANISM FOR ADVISING ON DEFENSE PROGRAMS DIRECTIONS. INTERACTION WITH THE DEPARTMENT OF DEFENSE ALSO PROVIDES CLOSE CUSTOMER FEEDBACK ON MAJOR ASPECTS OF PROGRAM PERFORMANCE.

THE DEPARTMENT ALSO USES FORMAL COMMITTEES COMPOSED OF OUTSIDE EXPERTS TO REVIEW OR ADVISE ON DEFENSE PROGRAMS, INCLUDING THE SAFETY, SECURITY, AND CONTROL COMMITTEE; THE WEAPON SAFETY ADVISORY REVIEW GROUP; AND THE INERTIAL CONFINEMENT FUSION ADVISORY PANEL. THE CONTAINMENT EVALUATION PANEL AND THE THRESHOLD TEST BAN REVIEW PANEL HAVE ALSO REVIEWED ISSUES RELATED TO NUCLEAR TESTING.

DEFENSE PROGRAMS ALSO USES INDEPENDENT OUTSIDE EXPERT GROUPS, SUCH AS JASON (A HIGHLY QUALIFIED ADVISORY BODY OF SCIENTISTS), TO REVIEW ITS CLASSIFIED PROGRAMS. THE NATIONAL ACADEMY OF SCIENCES HAS ALSO REVIEWED DEFENSE PROGRAMS TECHNICAL ACTIVITIES. A LARGE AMOUNT OF UNCLASSIFIED RESEARCH CONDUCTED WITHIN THE DEFENSE PROGRAMS IS PUBLISHED IN OPEN PEER-REVIEWED JOURNALS. THERE IS ALSO A CLASSIFIED PEER-REVIEWED JOURNAL TO WHICH LABORATORY RESEARCHERS ACTIVELY CONTRIBUTE.

IN THE CASE OF NUCLEAR DEVICE DESIGN AND MUCH OF THE RELATED WEAPONS SCIENCE AND TECHNOLOGY, DETAILED REVIEW REQUIRES ACTIVE EXPERTISE, AND THERE EXISTS NO BROAD INDUSTRIAL OR UNIVERSITY BASE FROM WHICH TO DRAW SUCH EXPERTS. HISTORICALLY, TECHNICAL COMPETITION HAS PROVEN INVALUABLE IN THIS FIELD AND PEER REVIEWS ARE SO DESIGNED INTO PROGRAM ACTIVITIES IN LARGE PART BY THE EXISTENCE OF TWO NUCLEAR DESIGN LABORATORIES, AT LAWRENCE LIVERMORE AND LOS ALAMOS. ONE-ON-ONE INTERACTIONS BETWEEN RESEARCHERS IN HIGHLY CLASSIFIED BUT RELATED FIELDS AT THESE TWO LABORATORIES ADD CONSIDERABLY TO THE QUALITY IMPROVEMENT PROCESS AT BOTH LABORATORIES.

SANDIA NATIONAL LABORATORY EMPLOYS AN EFFECTIVE MEANS OF INTRAMURAL REVIEW, USING "RED TEAMS" TO ENSURE THE SAFETY AND RELIABILITY OF SANDIA COMPONENTS AND PROCESSES. DEFENSE PROGRAMS HAS FURTHER ESTABLISHED A FORMAL INTERLABORATORY (LOS ALAMOS, LAWRENCE LIVERMORE, AND SANDIA) PEER REVIEW PROCESS FOR SPECIFIC WEAPON R&D, CERTIFICATION, AND SURVEILLANCE ACTIVITIES. FOR EXAMPLE, EVERY FIVE YEARS, WITH ANNUAL UPDATES, LAWRENCE LIVERMORE-SANDIA AND LOS ALAMOS-SANDIA TEAMS IN THE WEAPONS ASSESSMENT PROCESS CONDUCT PEER-REVIEWED STUDIES OF EACH OTHER'S STOCKPILE WEAPONS.

RECENT M&O CONTRACTS FOR LOS ALAMOS AND LAWRENCE LIVERMORE REQUIRE THE UNIVERSITY OF CALIFORNIA TO CONDUCT ANNUAL SCIENCE AND TECHNOLOGY SELF-ASSESSMENTS STRESSING EXTERNAL PEER REVIEWS WITH SPECIFIC CRITERIA. THESE ARE BEING IMPLEMENTED USING EVALUATIONS BY APPROPRIATELY CONSTITUTED EXTERNAL REVIEW COMMITTEES OF EXPERTS. THESE COMMITTEES, TAKEN TOGETHER, EVALUATE ALL TECHNICAL ACTIVITIES AT THESE LABORATORIES. THE UNIVERSITY OF CALIFORNIA PRESIDENT'S COUNCIL PANEL ON NATIONAL SECURITY REVIEWS THE WEAPONS PROGRAMS OF LOS ALAMOS AND LIVERMORE. PANEL MEMBERS INCLUDE TECHNICAL EXPERTS DRAWN FROM OUTSIDE THE UNIVERSITY OF CALIFORNIA AND LABORATORY COMMUNITIES. THESE AND OTHER MECHANISMS ARE USED TO ASSESS AND MAINTAIN QUALITY IN THESE PROGRAMS.

1 COMPARISONS WITH OTHER FEDERAL AGENCIES

MORE THAN 20 FEDERAL AGENCIES CARRY OUT R&D PROGRAMS. OF THESE, THE DEPARTMENT OF ENERGY'S R&D PROGRAM IS ONE OF THE LARGEST, BEING RESPONSIBLE FOR ABOUT 10 PERCENT OF THE TOTAL FEDERAL R&D BUDGET OF \$72 BILLION IN FISCAL YEAR 1994. IN ADDITION, THE DEPARTMENT OF ENERGY HAS PERHAPS ONE OF THE MOST DIVERSE SET OF MISSIONS, COMPLICATED BY THE UNIQUE DEMANDS OF NUCLEAR WEAPONS DESIGN.

BECAUSE OF THIS DIVERSITY AND SIZE, THE DEPARTMENT'S R&D PROGRAMS TAKEN TOGETHER RESEMBLE THE MANY FACETS OF FEDERAL R&D PROGRAMS AS A WHOLE. SIMILARLY, THE DEPARTMENT'S APPLICATION OF PEER REVIEW PRINCIPLES AND METHODS SHARE MANY OF THE STRENGTHS, AS WELL AS SOME OF THE WEAKNESSES, OF SUCH PRACTICES AS APPLIED TO FEDERAL R&D IN GENERAL. OTHER AGENCIES, FOR EXAMPLE, USE AN ARRAY OF PEER REVIEW METHODS, AT ALL ORGANIZATIONAL LEVELS, TO PROMOTE QUALITY, RELEVANCE, AND PRODUCTIVITY IN R&D PROGRAMS. THE DEPARTMENT, LIKEWISE, APPLIES THESE METHODS TO THE DIFFERENT LEVELS IN THE MANAGEMENT PROCESS HIERARCHY, AND TO THE DIFFERENT TYPES OF R&D ACTIVITIES, AS IS MOST APPROPRIATE TO EACH SITUATION.

THE NATIONAL INSTITUTES OF HEALTH, THE NATIONAL SCIENCE FOUNDATION, AND MANY PARTS OF THE DEPARTMENT OF ENERGY'S FUNDAMENTAL SCIENCE, HEALTH AND ENVIRONMENTAL RESEARCH, AND BASIC ENERGY SCIENCES PROGRAMS ALL HAVE EXTENSIVE EXTERNAL RESEARCH PROGRAMS IN THE PHYSICAL AND LIFE SCIENCES. EACH AGENCY USES SIMILAR PROSPECTIVE PEER REVIEW METHODS, BY MAIL, OR BY PANELS, BEFORE FUNDING PROPOSALS. SOME AGENCIES WITH THEIR OWN LABORATORIES ALSO MAKE AVAILABLE THEIR RESEARCH FACILITIES FOR THE BENEFIT OF OTHER USERS, SUCH AS THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S WIND TUNNELS. RESEARCH AT SUCH USER FACILITIES, LIKE THAT AT THE DEPARTMENT'S FACILITIES, IS MERIT-REVIEWED USING PROSPECTIVE PEER REVIEWS.

LIKE THE DEPARTMENT OF ENERGY, THE DEPARTMENTS OF DEFENSE AND COMMERCE (THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY), THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, AND, TO SOME EXTENT, THE NATIONAL INSTITUTES OF HEALTH (NIH) ALL CONDUCT INTERNAL LABORATORY RESEARCH PROGRAMS. EACH AGENCY RELIES PRIMARILY UPON IN-PROGRESS, RETROSPECTIVE REVIEWS FOR GUIDING AND GAUGING ITS INTERNAL LABORATORY RESEARCH.

IN THE AREA OF BASIC RESEARCH, THE NATIONAL INSTITUTES OF HEALTH IS AN AGENCY OFTEN CITED AS A MODEL FOR EMULATION IN ITS USE OF MERIT REVIEWS WITH PEER EVALUATION. NINETY PERCENT OF THE RESEARCH ACTIVITIES AT NIH ARE EXTERNAL, AND ARE SUBJECT TO A TWO-STAGE REVIEW PROCESS. IN THE FIRST STAGE AT NIH, A PANEL OF 15 TO 20 SCIENTISTS, EXPERTS IN THE RELEVANT FIELD, READ EACH PROPOSAL. GENERALLY, THREE PANEL MEMBERS REVIEW EACH PROPOSAL IN DETAIL AGAINST SPECIFIED CRITERIA AND PREPARE FORMAL BRIEFS, WHILE THE OTHER PANELISTS FAMILIARIZE THEMSELVES WITH EACH PROPOSAL. ALL PANELISTS TAKE PART IN A GROUP DISCUSSION AND VOTE FORMALLY. THE PANEL THEN REPORTS TO A NATIONAL ADVISORY COUNCIL FOR THE SECOND STAGE. EACH INSTITUTE OF THE NIH HAS A SINGLE NATIONAL ADVISORY COUNCIL OF AT LEAST 12 MEMBERS, NOT ALL OF WHOM ARE NECESSARILY SCIENTISTS (IN MOST PROPOSALS, THERE ARE CONSIDERATIONS BEYOND PURE SCIENCE).

REVIEW OF INTERNAL LABORATORY RESEARCH AT THE NIH IS CONDUCTED BY THE BOARD OF SCIENTIFIC COUNSELORS FOR EACH INSTITUTE. EACH BOARD CONSISTS OF OUTSIDE SCIENTISTS CHOSEN FOR THEIR EXPERTISE RELATED TO EACH INSTITUTE. HOWEVER, IT SHOULD BE NOTED THAT MANY BOARD MEMBERS ARE FUNDED BY THE INSTITUTE UNDER REVIEW.

AN AUTHORITATIVE CRITIQUE¹⁹ OF THE NIH PEER REVIEW SYSTEM CONCLUDED THAT (A) THE EXCELLENCE OF THE OVERALL NIH RESEARCH PROGRAM IS BUILT ON A VARIETY OF APPROACHES TO MANAGING RESEARCH, USING BOTH PROSPECTIVE AND RETROSPECTIVE REVIEWS; (B) PROSPECTIVE AND RETROSPECTIVE PEER REVIEW HAVE DIFFERENT STRENGTHS AND WEAKNESSES, AND ENCOURAGE CREATIVITY IN DIFFERENT WAYS; AND (C) THE OVERALL NIH RESEARCH PROGRAM WAS BEST SERVED BY RETAINING PROSPECTIVE REVIEW IN ITS EXTERNAL (FOR EXAMPLE, R&D SUPPORT VIA GRANTS) PROGRAMS AND RETROSPECTIVE REVIEW IN ITS INTERNAL (FOR EXAMPLE, IN-HOUSE LABORATORY) PROGRAMS.

AS STRONG AS THE NIH AND OTHER AGENCY PEER REVIEW PRACTICES APPEAR TO BE, IN EACH AREA WHERE COMMONALITY EXISTS AMONG RESEARCH KIND (FOR EXAMPLE, BASIC RESEARCH) AND COMMUNITIES (FOR EXAMPLE, UNIVERSITIES, RESEARCH CENTERS), THE DEPARTMENT OF ENERGY HAS WELL-ESTABLISHED PEER REVIEW PRACTICES THAT ARE QUITE COMPARABLE AND, PERHAPS, BETTER IN SOME AREAS. THIS COMPARABILITY NOTWITHSTANDING, THE DEPARTMENT CAN ONLY BENEFIT BY EXAMINING MORE THOROUGHLY AND UNDERSTANDING MORE COMPLETELY THE BEST PRACTICES OF OTHER AGENCIES. TO THIS END, THE DEPARTMENT INTENDS TO CONTINUE ITS STUDY OF OTHER AGENCY PRACTICES, PARTICIPATE IN INTERAGENCY FORUMS ON PEER REVIEW, AND IMPLEMENT SOME PILOT PROGRAMS TO TEST INNOVATIVE APPROACHES.

THE SHARING OF PEER REVIEW STRENGTHS, HOWEVER, MEANS THAT THE DEPARTMENT MAY ALSO SHARE SOME OF ITS WEAKNESSES. THE PROCESS OF MERIT REVIEW WITH PEER EVALUATION, IN GENERAL, IS UNDER PRESSURE AND HAS BEEN CRITICIZED BY MANY IN THE RESEARCH COMMUNITY, IN PART, DUE TO ITS COST, COMPLEXITY, ADMINISTRATIVE BURDEN, LACK OF AVAILABLE PEERS, SLOWNESS, AND QUESTIONS ABOUT EQUITY AND FAIRNESS. EVEN WITH THESE CONCERNS, HOWEVER, PEER REVIEW IS STILL WIDELY REGARDED AS THE BEST METHOD AVAILABLE FOR ALLOCATING SCARCE R&D RESOURCES. ACCORDINGLY, THE DEPARTMENT OF ENERGY SEEKS WAYS TO BOTH RESPOND TO THESE CONCERNS AND DEVELOP IMPROVED PEER REVIEW SYSTEMS, AS OUTLINED BELOW.

1 CONCLUSIONS AND OPPORTUNITIES FOR IMPROVEMENT

AS DOCUMENTED IN THIS PAPER, THE DEPARTMENT OF ENERGY USES PEER REVIEW EXTENSIVELY THROUGHOUT ITS R&D PROGRAMS TO BOTH GUIDE RESEARCH DIRECTION (PROSPECTIVE PEER REVIEW) AND GAUGE RESEARCH PROGRESS (RETROSPECTIVE PEER REVIEW). IN MANY INSTANCES, BOTH FORMS OF PEER REVIEW ARE APPLIED TO THE SAME RESEARCH ACTIVITY. THE DEPARTMENT'S PEER REVIEW PRACTICES IN MANY OF ITS MORE MATURE R&D PROGRAMS MAY BE COUNTED AMONG THE BEST PRACTICES OF ALL AGENCIES. PEER REVIEW PRACTICES IN SOME OF THE MORE RECENTLY ESTABLISHED AND GROWING R&D PROGRAMS ARE EVOLVING AND BEING STRENGTHENED. VIRTUALLY ALL MAJOR R&D PROGRAMS EXPERIENCE MULTIPLE LEVELS OF REVIEW BY QUALIFIED AND INDEPENDENT REVIEW AND ADVISORY COMMITTEES.

EXTERNAL R&D ACTIVITIES CONDUCTED VIA GRANTS, CONTRACTS, AND COOPERATIVE AGREEMENTS ARE GOVERNED BY AN ELABORATE SYSTEM OF STATUTORY, REGULATORY, AND PROCEDURAL REQUIREMENTS THAT VIRTUALLY ENSURE THAT THE VAST MAJORITY OF R&D AWARDS ARE SUBJECT TO MERIT REVIEWS WITH PEER EVALUATION AND COMPETITIVE SELECTION. INTERNAL LABORATORY R&D ACTIVITIES ARE LIKEWISE SUBJECT TO MULTIPLE REVIEWS BY PEERS, BOTH PROSPECTIVE AND RETROSPECTIVE, WITH INCREASING COMPETITION. RETROSPECTIVE MERIT REVIEWS WITH PEER EVALUATION HAVE BEEN CONFIRMED BY INDEPENDENT STUDIES AS AN EFFECTIVE MEANS FOR PROMOTING RESEARCH RELEVANCE AND PRODUCTIVITY IN THE LABORATORIES. MOREOVER, IN MANY DEPARTMENTAL LABORATORY R&D PROGRAMS, RETROSPECTIVE REVIEWS ARE INCREASINGLY BEING SUPPLEMENTED BY PROSPECTIVE REVIEWS OF LABORATORY FIELD WORK PROPOSALS, WHERE APPROPRIATE. ADMINISTRATIVE REQUIREMENTS FOR COST-SHARING AND JOINT PLANNING OF APPLIED R&D WITH INDUSTRY ADD FURTHER TO THE CHECKS AND BALANCES OF R&D MANAGEMENT. IN APRIL 1994, THE DEPARTMENT REAFFIRMED ITS STRONG COMMITMENT TO PEER REVIEW IN ITS STRATEGIC PLAN, FUELING A COMPETITIVE ECONOMY, BY SPECIFYING THAT AN IMPORTANT "SUCCESS INDICATOR" FOR ITS SCIENCE AND TECHNOLOGY PROGRAMS IS

"QUALITY OF SCIENCE, AS INDICATED BY FAVORABLE OUTSIDE PEER REVIEWS AND JUDGMENT OF EXPERT ADVISORY COMMITTEES."

RECOGNIZING THE IMPORTANCE OF PEER REVIEW, HAVING SURVEYED PEER REVIEW PRACTICES AT OTHER FEDERAL AGENCIES, AND HAVING REVIEWED THE

¹⁹National Institutes of Health, "Report of the External Advisory Committee of the Director's Advisory Committee." (Washington, DC: National Institutes of Health, April 1994).

SUGGESTIONS OF SUCH EXPERTS AS CHUBIN AND HACKETT,²⁰ BOZEMAN,²¹ AND KOSTOFF²² FOR THE EVALUATION AND IMPROVED USE OF PEER REVIEW, THE DEPARTMENT INTENDS TO STRENGTHEN FURTHER ITS USE OF PEER REVIEW, IN FORMS APPROPRIATE TO ITS MISSIONS, IN ALL OF ITS TECHNICAL PROGRAMS, AND AT ALL LEVELS OF DECISIONMAKING.

IN SO PROCEEDING, THE DEPARTMENT RECOGNIZES THAT SERIOUS REVIEWS CAN IMPOSE MAJOR COSTS ON THOSE BEING REVIEWED, AS WELL AS ON THE REVIEWERS AND SUPPORTING STAFF. PEER REVIEW SYSTEMS CAN INTRODUCE SIGNIFICANT DELAYS IN R&D PROGRAM EXECUTION. IF IMPLEMENTED TOO RIGIDLY, PEER REVIEW SYSTEMS CAN STIFLE FLEXIBILITY AND CREATIVITY. THE EXPERIENCES OF SEVERAL R&D AGENCIES SUGGEST THAT IT IS POSSIBLE TO CREATE ELABORATE SYSTEMS OF OVERLAPPING REVIEWS THAT ARE UNNECESSARILY COMPLEX AND BURDENSOME. BEING AWARE OF THESE POTENTIAL RISKS, THE DEPARTMENT HAS IDENTIFIED THREE BROAD AREAS FOR IMPROVEMENT.

1 ENHANCED APPLICATION OF PEER REVIEW

FIRST, WHILE RECOGNIZING THE NEED FOR FLEXIBILITY AND EFFICIENCY, THE DEPARTMENT OF ENERGY WILL SEEK TO ENHANCE THE USE AND APPLICATION OF PEER REVIEW AT ALL APPROPRIATE LEVELS OF R&D PROGRAM MANAGEMENT AND EXECUTION.

- PEER REVIEW APPLIED AT THE HIGHEST LEVEL OF MANAGEMENT CHECKS THE RESEARCH AGENDA AND HELPS TO INFORM THE PROCESSES THAT ESTABLISH TOP-LEVEL GUIDANCE FOR R&D PRIORITIES THROUGHOUT THE AGENCY. FILLING A GAP IN SUCH COVERAGE, AN ADVISORY TASK FORCE FOR STRATEGIC ENERGY R&D, SIMILAR TO THOSE ADVISING THE SECRETARY ON SCIENCE AND DEFENSE MATTERS, WILL BE CHARTERED TO SERVE THIS FUNCTION UNDER THE AUSPICES OF THE SECRETARY OF ENERGY ADVISORY BOARD.
- WHERE APPROPRIATE, GAPS WILL ALSO BE FILLED IN THE COVERAGE OF EXPERT ADVISORY COMMITTEES AT THE ASSISTANT SECRETARY LEVEL AND IN THE USE OF OUTSIDE EXPERT PEER REVIEWS AT THE MAJOR R&D PROGRAM LEVEL.
- RECOGNIZING THAT OUTSTANDING LEADERSHIP CAN OFTEN TAKE R&D PROGRAMS TO GREAT HEIGHTS OF ACCOMPLISHMENT, THE DEPARTMENT WILL INCLUDE R&D PROGRAM LEADERSHIP, AT BOTH DEPARTMENTAL HEADQUARTERS AND IN THE FIELD, AS A SPECIFIC ELEMENT IN FUTURE MAJOR R&D PROGRAM REVIEWS.
- IN ITS LABORATORY SYSTEM OF FIELD WORK PROPOSALS, THE DEPARTMENT WILL ENCOURAGE ENHANCED QUALITY OF FWPs AND THE EXPANDED USE, WHERE APPROPRIATE, OF PROSPECTIVE MERIT REVIEWS WITH PEER EVALUATION OF FWPs FOR NEW PROJECTS, EMULATING CURRENT PRACTICES OF MANY OF THE DEPARTMENT'S BASIC RESEARCH PROGRAMS.
- AT THE OUTSET OF NEW MAJOR R&D PROGRAM INITIATIVES, PLANS WILL BE ESTABLISHED, AS APPROPRIATE, TO APPLY PEER REVIEW PRINCIPLES AND METHODS AT ALL SUITABLE LEVELS.
- IN IMPLEMENTING THE DEPARTMENT'S INITIATIVES IN CONTRACT REFORM, MEASUREMENTS OF CONTRACTOR PERFORMANCE, INCLUDING M&O CONTRACTORS, WILL BE EXTENDED, AS APPROPRIATE, TO INCLUDE AN EVALUATION OF THE USE OF PEER REVIEW PRINCIPLES AND METHODS.

1 IMPROVED PEER REVIEW PROCESSES

SECOND, THE DEPARTMENT OF ENERGY'S MANAGEMENT OF ITS PEER REVIEW PROCESSES WILL BE STRENGTHENED, INCLUDING THE ESTABLISHMENT OF GUIDING POLICIES AND PRINCIPLES, IMPROVED OVERSIGHT, AND BROADENED DOCUMENTATION OF USE.

- THE DEPARTMENT WILL BUILD ON THE SUCCESSFUL PEER REVIEW RECORD OF MANY OF ITS PROGRAMS, AND ESTABLISH GUIDELINES FOR CONDUCTING PEER REVIEW AT VARIOUS LEVELS OF MANAGEMENT, TAILORING THEM TO MEET THE PARTICULAR INFORMATION NEEDS AND UNIQUE FEATURES OF THE PROGRAMS AND MISSIONS TO WHICH THEY WOULD APPLY.
- PERIODIC AND RANDOM SAMPLING WILL ASSESS THE USE AND EFFECTIVENESS OF THE PEER REVIEWS AND IDENTIFY AREAS FOR IMPROVEMENT. THIS MAY ALSO INCLUDE BROADENED COVERAGE OF THE IN-PROGRESS PEER REVIEW PROGRAM CURRENTLY UNDER WAY IN THE OFFICE OF ENERGY RESEARCH.
- A PROCESS FOR LINKING PEER REVIEW PRINCIPLES AND METHODS AND OTHER EVALUATIVE ACTIVITIES TO THE DEPARTMENT'S STRATEGIC PLANNING, BUDGET FORMULATION, AND PERFORMANCE MANAGEMENT ACTIVITIES WILL BE DEVELOPED AND IMPLEMENTED, IN CONJUNCTION WITH RELATED EFFORTS RESPONDING TO THE CHIEF FINANCIAL OFFICER ACT AND THE GOVERNMENT PERFORMANCE AND RESULTS ACT.
- THE DEPARTMENT WILL EXPLORE WAYS TO REWARD THE EFFECTIVE USE OF PEER REVIEW, INCLUDING SIMPLIFICATION OF ADMINISTRATIVE PROCEDURES AND RELAXATION OF OVERSIGHT CONTROLS, IN AREAS WHERE R&D EXCELLENCE HAS BEEN DEMONSTRATED.

1 PEER REVIEW RESEARCH AND INNOVATION

THIRD, THE DEPARTMENT WILL BE A LEADER IN EXAMINING PEER REVIEW PROCESSES AND BEST PRACTICES, AND IN DEVELOPING AND IMPLEMENTING RECOMMENDATIONS FOR IMPROVEMENTS IN THE APPLICATION OF PEER REVIEW TO TODAY'S SCIENCE AND TECHNOLOGY ENVIRONMENT.

²⁰Chubin, Daryl E., et al., op. cit.

²¹Bozeman, B., "Peer Review and Evaluation of R&D Impacts", in ed. Bozeman, B., and Melkers, J., *Evaluating R&D Impacts: Methods and Practice*, p. 79-98. (Boston, MA: Kluwer Academic Publishers, 1993).

²²Kostoff, R., "Assessing Research Impact: Federal Peer Review Practices", in ed. Kostoff, R., *Evaluation Review* vol. 18, No. 1, p. 31-40. (Sage Publications, February 1994).

- *AS PART OF THE DEPARTMENT'S OVERSIGHT OF PEER REVIEW PRACTICES AND INCREASED USE OF PERFORMANCE-BASED CONTRACTING, COLLECTION OF DATA ON THE PRACTICE AND NATURE OF VARIOUS FORMS OF PEER REVIEW WILL BE ESTABLISHED. INFORMATION ON CURRENT PEER REVIEW PRACTICES WILL ADDRESS, TO THE EXTENT PRACTICABLE, METHODS, COSTS, AND BENEFITS, AND IDENTIFY AREAS OF IMPROVEMENT.*
- *RESEARCH ON IMPROVED METHODS FOR PEER REVIEW WILL BE ENCOURAGED AND COMMUNICATED. TRADEOFFS MUST BE ADDRESSED BETWEEN ACCOUNTABILITY AND SCIENTIFIC FREEDOM, EFFICIENCY AND THOROUGHNESS, AS MUST ISSUES OF THE EFFECTIVENESS, ROBUSTNESS, RESPONSIVENESS, FAIRNESS OF REVIEW, AND ADHERENCE TO TECHNICAL STANDARDS OF GOOD MEASUREMENT, INCLUDING VALIDITY AND RELIABILITY.*
- *A STUDY, INCLUDING SURVEYS OF THE LITERATURE AND INTERVIEWS WITH BOTH PRIVATE AND FEDERAL AGENCY R&D MANAGERS, WILL EXAMINE THE VARIOUS MODELS FOR CONDUCTING FEDERAL R&D AND PROPOSE INNOVATIVE APPROACHES TO THE APPLICATION AND USE OF PEER REVIEW TO THE ACCOMPLISHMENT OF THE DEPARTMENT'S R&D MISSIONS.*
- *A SERIES OF PILOT PROGRAMS WILL BE ESTABLISHED TO TEST THE EXPANDED USE OF PEER REVIEW, OR MODIFICATIONS OF PEER REVIEW, IN AREAS WHERE IT IS NOT NOW UNIFORMLY APPLIED, OR WHERE PROSPECTIVE REVIEWS MIGHT BE BENEFICIALLY SUBSTITUTED FOR SOME RETROSPECTIVE REVIEWS, SUCH AS IN SOME OF THE DEPARTMENT'S INTERNAL LABORATORY R&D PROGRAMS.*
- *WHILE SOME PARTS OF THE DEPARTMENT HAVE EXCELLENT PEER REVIEW SYSTEMS ALREADY IN PLACE, NEW CRITERIA FOR SELECTION AND EFFECTIVE USE OF PEERS WILL BE DEVELOPED AND ADDED TO DEPARTMENTAL GUIDELINES, AS NEEDED. THESE CRITERIA MAY ADDRESS SUCH ISSUES AS THE COMPETENCE AND OBJECTIVITY OF PEERS AND METHODS TO DEAL WITH REVIEWER BIAS AND DYSFUNCTIONAL GROUP DYNAMICS.*

Appendix D-3 Suggested Framework for Merit Review

Program Evaluation

How should the quality of EERE programs and projects be assessed? What role should advisory committees play in both formulating and evaluating the EERE program? What is the role of merit and peer review in the decision-making process? Is a uniform merit and peer review process necessary or desirable? Is merit and peer review a guide or determinant to the program manager? At what stage in the decision-making process do programmatic and societal considerations come into play? How should the need to meet broader nontechnical goals influence EERE's priorities? How can the effectiveness, productivity, and impact of the EERE programs be measured?

A. Assessing and Ensuring Quality

Excellence is the key to EERE's achievements. In planning its projects and programs, in choosing research and development to support, and in selecting the participants in these activities, EERE's focus will be on excellence. It will achieve excellence by selecting the best ideas to be carried out by highly capable people, thereby providing the American public the greatest return on its investments in EERE programs.

A key to excellence is open competition and merit review. These will be the bases for deciding on participation in EERE programs.

Merit review will generally be used in selecting among competitors, but other forms of merit review may be used as well. The peer and merit review processes used in various parts of the EERE program will be documented and assessed periodically for appropriateness, efficiency, and effectiveness. EERE is committed to ensuring a level playing field in the competition for new projects and supporting research.

EERE is committed to establishing, maintaining, and measuring quality based on informed judgments, multiple lines of evidence, and views from both the participants in and beneficiaries of EERE programs. Many different mechanisms are available for assessing and ensuring quality. Each of these mechanisms can play a significant role at some stage in the decision-making and evaluation process.

These mechanisms include:

- the use of external advisory committees to help establish major directions for EERE's programs or program priorities,
- the use of scientific project or discipline-oriented working groups (composed of EERE and non-EERE members) to help define projects or programs, look at balance and quality within a given program area, or assess progress on a project,
- visiting committees to assess institutional programs; the use of traditional peer review applied to fair and open competition to support decision-making regarding the support of individual tasks, and
- relying on the informed judgment of technically and scientifically competent program managers.

The appropriate use of expert review groups to assess progress on projects in development is also an important part of enhancing quality. EERE uses all of these mechanisms as appropriate to ensure the quality of its programs.

Assessments of the quality, effectiveness and impact of EERE projects and programs will be made on a regular basis through all stages of a program's or project's lifetime:

- when programs and projects are first identified and defined,
- when the actual participants are selected to carry out the work,
- during development and implementation for activities having well defined costs, schedules, and milestones,
- whenever major new scientific, technical, or programmatic developments raise significant questions about a particular program's validity or approach,
- following completion of a project's prime operating phase to see whether continued operations are warranted, and
- following project or program completion to see whether a

program's goals were actually achieved and to assess the broad scientific and/or other contributions made by a given program.

Effort will be made to ensure consistent criteria over the life of a program. Continuing programs will be assessed on a periodic basis.

Such assessments are necessary not only for EERE self-evaluation, but also to meet new legislative mandates such as the Government Performance and Results Act of 1993. Further, EERE is committed to developing explicit criteria for making decisions and assessing quality and making both the criteria and the way the criteria are applied publicly available. EERE's decision making will be based on principles, which are broadly disseminated and are well understood by all participants.

B. External Review

Two mechanisms for evaluating quality that involve the external community, advisory committees and peer review, are of particular importance.

i. The Use of Advisory Committees

Advisory Committees and other external groups will continue to have a key role to play in the formulation and oversight of EERE's programs to ensure the highest quality in the national interest. EERE will seek advice, analysis and assistance from external communities. Although EERE has the ultimate responsibility for program formulation and evaluation, EERE seeks assistance in these and other tasks from, for example, the National Academies of Science and Engineering and through mechanisms such as EERE-formed advisory committees, working groups, management operations groups, steering committees and program review bodies.

The National Academies of Sciences and Engineering and the Institute of Medicine, for example, provide broad, often long-range advice, particularly concerning goals, objectives, strategies and priorities. EERE-formed committees and groups focus more on programmatic issues and detailed technical questions. Both types of information are important for the planning and implementation of EERE programs and projects.

Members of such groups will be selected on the basis of individual competence and will come from a wide range of institutions, backgrounds and perspectives. Memberships on such groups will rotate on a regular basis to broaden the advice received and will include individuals not directly involved in EERE activities.

It must also be recognized that Advisory Committees and other external groups, while providing a vital mechanism for external community involvement in and ownership of EERE programs, are not always in a position to consider the full range of criteria that EERE must address including political, budgetary and programmatic issues. EERE managers must therefore combine the advice and information they receive from such groups with other information on priorities, costs, etc. to reach final decisions. In all cases, however, the criteria on which decisions are based will be made explicit.

ii. Peer Review

Along with strategic planning and program evaluation, the use of peer review is an integral part of EERE's practices to ensure quality. In general, EERE evaluates program merit and priorities on the basis of peer review and advice from committees broadly representative of our customers.

Peer review is a process in which an unbiased group judges the significance and technical validity of proposed work of members of its own community. The goals of peer review are to:

- determine the quality, relevance, and value of the work being judged;
- identify the work most likely to succeed;
- investigate the relative merits of similar work proposed by competing groups; and
- demonstrate to internal and external communities that balance and fairness are achieved in arriving at decisions by making the relevant communities of experts themselves participants in the selection process.

EERE subscribes to these goals and will fully utilize peer review to ensure that fairness and quality are the foundations on which decisions concerning participation in its scientific programs are based.

To accomplish the goals of peer review, EERE will strive to ensure that:

- reviewers are genuinely knowledgeable and collectively cover the full range of expertise required for thorough proposal evaluation;
- attention is paid to conflicts of interest;
- EERE programmatic and technical needs and requirements are understood; they will be spelled out in the relevant solicitation; and
- criteria for evaluation are well defined and understood; accepted by the reviewers; traceable to the needs and requirements outlined in the solicitation; and spelled out in that solicitation.

A central role for EERE headquarters is to form diverse, expert review panels which encompass the full range of expertise required. Such expertise must be drawn from the widest possible talent pool. EERE Headquarters must also ensure that peer review panels are adequately informed about the requirements and constraints that proposals are expected to satisfy and that are an important part of the basis for evaluation. Another role is to identify and eliminate potential conflicts of interest in the peer review process. Since factors other than peer review may enter the decision-making process (see below), final selections are always the purview of an EERE official.

While the general principle regarding the use of competition and peer review applies across the Agency, an EERE-wide set of criteria or a uniform review process does not appear to be necessary. Different approaches are warranted by differences in goals, customer base, etc. among the various disciplines.

C. Other Factors Entering the Decision-Making Process

Although the results of peer review are exceedingly important, other factors may enter the decision-making and selection process. Policy directions or programmatic considerations (such as programmatic balance, cost) play a significant role.

One example of a justified departure from the principle of open competition and peer review is new activities or innovative but risky ideas that promise high gain. EERE is committed to funding

such projects for a limited period of time with seed money to develop them to the point where they can compete. Managers may also select work needed to achieve particular programmatic needs. The results of such activities will be reviewed on a regular basis. In cases where commercial products may result from the research, internal government-only review may be most appropriate to protect proprietary information.

Programmatic or societal considerations can enter the decision-making process at several stages. Contributions to broad national needs identified by the Secretary, Administration or Congress play a substantial role in establishing priorities and in shaping or arriving at the decision to proceed with a particular project or program. EERE is part of the political system and its priorities are determined within that context.

For a given program, all considerations that are to play a significant role in the decision-making process (including, for example, contributions to technology and economic competitiveness) will be clearly spelled out in program and project participation solicitations and appropriate evaluation criteria identified. Peer review panels may then be suitably augmented to include appropriate expertise. Alternatively, peer review panels may focus on purely scientific and technical matters to define a competitive range within which programmatic, societal and other factors can then be used as discriminators in the final selection.

The application of these other factors is then the responsibility of the selecting official. Other approaches are also possible. Whatever approach is to be taken will be spelled out in advance so that all interested parties understand the process that will be used and the basis on which decisions will be made.

D. Metrics

There are increasing demands for all Federal programs to measure the performance and effectiveness of their programs. The Government Performance and Results Act of 1993 requires each Federal Agency to develop a strategic plan, set yearly goals and performance objectives for every major program area, and measure and report how well programs accomplish these goals. EERE also needs improved assessments of the effectiveness and contributions of its programs. In response to these requirements, a number of efforts are now underway both inside and outside of EERE to define and develop metrics for assessing the value and

contributions of EERE programs.

EERE consults with its stakeholders and others to develop a meaningful and useful set of metrics. In developing these metrics, a number of general considerations are being taken into account:

- No single metric or group of metrics is likely to apply to EERE on a broad scale. Appropriate metrics have to be developed for different parts of the EERE program.
- In general, projects and programs have three distinct (but coupled) phases, each of which requires a different set of metrics.
 - The Program Initiation Phase for which metrics are focused on evaluating the importance of a program vis-a-vis competing programs, state-of readiness for initiation, and the level of resources needed for development. Scientific or technical merit, programmatic considerations, and contributions to meeting larger public needs may all play a role at this stage. Criteria to be developed also must be explicitly linked to EERE and the EERE programs able to make progress towards achieving their Vision.
 - The Program Development or Implementation Phase for which metrics are focused on measuring expected accomplishments or performance vs. cost and schedule.
 - The Program Retrospective Phase for which metrics are focused on understanding the degree to which intended goals were achieved and larger public benefits derived. Retrospective phase metrics must provide a genuine measure of value, must give the political system the information that it needs, must satisfy legitimate demands for accountability, and must measure true effectiveness and not just activity.
- It is generally easier to develop metrics for short-term activities that have a clear goal from their outset, than for long-term activities whose full impact is often not realized for many years and then in unexpected ways. Retrospective metrics are therefore often the most effective for evaluating the contributions of the latter.
- Metrics are needed to assess the effectiveness of EERE

efforts to broaden participation in particular, to evaluate progress in broadening the responsibilities of universities and industry, in the formation of partnerships between EERE and these and other organizations, and in the inclusion of under represented groups.

Each evaluation should include metrics to assess the effectiveness and efficiency of EERE management of the programs and projects being evaluated.